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(71) Applicant: UNIVERSITEIT TWENTE
Drienerlolaan 5
NL-7522 NB Enschede(NL)

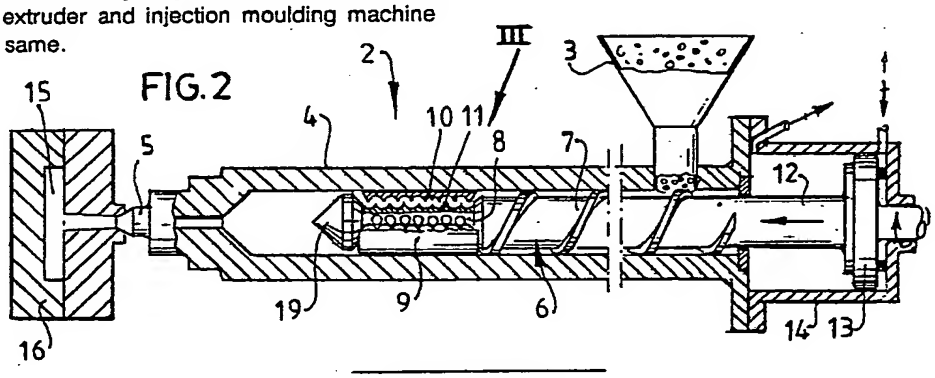
(72) Inventor: Semmekrot, Gerardus Johannes Maria
Gagelstraat 14
NL-7622 VL Borne(NL)

(74) Representative: Prins, Hendrik Willem et al
Octrooibureau Arnold & Siedsma
Sweelinckplein, 1
NL-2517 GK The Hague(NL)

(54) Mixer device with distribution mixing action for an extruder, an injection moulding machine and the like.

(57) The invention relates to a mixer device with distributive mixing action for an extruder, an injection moulding machine and the like, comprising a hollow stator (4) and a rotor (6) arranged for rotation in said stator and distributively acting mixing means, characterized by at least one separate mixing ring (9) which is provided at least on its interior surface with said mixing means (10) and which is arranged between said rotor (6) and stator (4) around said rotor in a manner such that during mixing there is a positive rotational speed difference between said rotor (6) and said mixing ring (9), to the mixing ring and to the extruder and injection moulding machine comprising same.

FIG.2



EP 0 340 873 A1

Mixer device with distribution mixing action for an extruder, an injection moulding machine and the like

The present invention relates to a mixer device with distributive mixing action for an extruder, an injection moulding machine and the like, comprising a hollow stator, a rotor arranged for rotation in the stator and distributively acting mixing means.

A known mixer device is for example described in British patent specifications 930.339 and 1.475.216 and the European patent application 48.590.

With such a known mixer device of the so-called cavity transfer type the mixing means consist of mutually co-acting mixing cavities arranged in the exterior surface of the rotor and in the interior surface of the stator. These mixing cavities can be arranged peripherally in staggered rows in the rotor and stator as in the European patent application 48.590 whereby rows of mixing cavities are arranged axially staggered in the stator and rotor.

The known mixer device according to the above stated patent publications requires the arrangement of mixing cavities in the interior surface of the stator across an axial length which for an extruder is substantially equal to the mixing section of the rotor and in the case of an injection moulding machine substantially equal to the stroke length of the mixing section of the rotor. The arrangement of these mixing cavities in the interior surface of the stator entails relatively high production costs, while the mixing sections in the rotor and stator must be geared to one another, which decreases the extent of interchangeability.

Another similar mixer device is the pin mixer whereby the mixing means comprise pins arranged spread in axial planes over the interior surface of the stator which extend as far as breaks in the rotor screw thread(s).

The invention has for its object to lessen the previously mentioned drawbacks and is characterized by at least one separate mixing ring which is provided with the mixing means at least on its interior surface and which is arranged between the rotor and stator around the rotor in a manner such that during mixing there is a positive rotational speed difference between the rotor and the mixing ring. The invention is based on the insight that such a mixing ring, as a result of the shearing forces of the viscous material present which affect it in combination with suitably chosen clearances on the outside and inside of the mixing ring, rotates at a speed of revolution less than the speed of revolution of the rotor. In practice the speed of revolution of the mixing ring has been found to be 5-20% of the speed of revolution of the rotor. This difference in the speed of revolution is sufficient for the realization of an adequate mixing action. In this way a stator with a smooth inner surface can be used.

Should the rotational speed difference be insufficient under certain practical circumstances, the mixing ring can then be locked against co-rotation with the rotor.

The mixing ring is preferably arranged for free rotation around the rotor.

A very simply manufactured mixing ring is obtained when preferably the mixing ring cavities are passages arranged in the mixing ring and the passages are in addition radially directed. Thus avoided is the occurrence of dead corners and degeneration of the material for mixing as the result of it remaining for too long a time in a mixing cavity, because there occurs in a mixing cavity an internal mixing as a result of the movement along the interior surface of the stator.

Should the mixing ring be provided with passages the rotor surface enclosed by the mixing ring can also be smooth, resulting in production costs being considerably lower with an equally good mixing action. With material transport in mind the passages can preferably be connected by lengthwise grooves which are more preferably arranged in a helical manner in the mixing ring surface. Thus realized is a specific adjustment of the mixer device to the material for mixing. In the case of a pin mixer the mixing means comprise pins protruding from the interior surface of the mixing ring into the space between the mixing ring and the rotor.

If after mixing of the viscous material this material is ejected using the axially slidable rotor and flow-back of the material has to be avoided for this purpose, the mixing ring can be further provided with an annular valve body which co-acts with a valve seat arranged on the rotor.

The mixing ring can be arranged simply on the rotor if in preference a rotor section enclosed by the mixing ring is detachably connected to the adjoining part of the rotor.

The invention finally relates to this rotor section and to an extruder, an injection moulding machine and the like which are provided with such a mixer device or rotor section.

Mentioned and other features will be elucidated hereafter with reference to a number of embodiments of a mixer device according to the invention, which embodiments are given by way of example. Reference is made hereby to the annexed drawing.

In the drawings:

figures 1 and 2 each show respectively views of a section of an extruder and an injection moulding machine according to the invention;

figure 3 is detail III from figure 2 on a larger scale;

figure 4 shows a section along the line IV-IV from figure 3;

figures 5, 7, 9 and 11 each show a view corresponding to figure 3;

figures 6, 8, 10 and 12 each show a section along respectively line VI-VI from figure 5, line VIII-VIII from figure 7, line X-X from figure 9 and line XII-XII from figure 11;

figure 13 is a perspective view on a larger scale of the mixing ring according to the invention from figure 11; and

figure 14 is a perspective view of a variant of the mixing ring in figure 13.

Figures 1 and 2 show respectively an extruder 1 and an injection moulding machine 2 according to the invention.

The extruder 1 comprises a hollow cylindrical stator 4 having an injection nozzle 5 and provided with a supply funnel 3. A rotatable rotor 6 is arranged in the stator 4. The rotor 6 comprises a threaded section 7 and a mixing section 8. The mixing section 8 comprises a mixing ring 9 arranged for free turning around the rotor and provided on its interior surface with mixing ring cavities 10 which are situated opposite to and co-act with rotor mixing cavities 11 arranged in a narrowed portion of the rotor 6.

Figure 2 shows the injection moulding machine 2 according to the invention. The construction elements corresponding with the extruder 1 are indicated with the same reference numerals. In this case the rotor 6 is provided with a piston rod 12 with the piston 13 which is slidably and rotatably guided in the piston chamber 14. In figure 2 the rotor 6 can execute a rotation and translation movement. During the translation mixed, viscous material is ejected into the die cavity 15 of the die 16. In order to avoid flowback of material during the injection moulding the mixing ring 9 is provided with an annular valve body 17 which co-acts with a valve seat 18 arranged on the rotor such that during injection moulding the passage between the mixing ring and the rotor is closed off by the annular valve body 17.

For optimal transport of the material along the rotor nose 19 the latter can be provided with lengthwise grooves 20 (figure 3).

Figures 3 and 4 show in more detail the mixing section of the rotor 6 from figure 2. This mixing section can also be applied in the extruder 1 according to fig. 1, with or without the annular valve body 17 with its valve seat 18.

In the narrowed rotor portion 21 the rotor mixing cavities 22 and 23 are arranged peripherally in staggered rows relative to each other. Rows of mixing ring cavities 24 and 25 respectively are arranged in similar manner in the interior surface of the mixing ring 9. During mixing the mixing ring 9 undergoes a force in forward direction through the flow of the material for mixing which results in it being pressed against the rotor nose 19. Owing to the presence of the material and the embodiment of the contact surfaces there is little friction hereby so that the rotational speed difference between the rotor 6 and the mixing ring 9 is hardly influenced. In this situation the mixing ring cavities 24 and 25 and the rotor mixing cavities 22 and 23 are axially displaced relative to each other in the configuration most favourable for mixing.

The mixing ring 9 can slide easily onto the rotor part 21 when this part is detachably fastened to the threaded section 7 of rotor 6.

Figures 5 and 6 show a variant whereby the mixing ring 26 is provided with radially directed passages 27 arranged therein in the same pattern as the mixing ring cavities 24 and 25. This mixing ring 26 is very simple to machine manufacture.

In the variant according to figures 7 and 8 the mixing ring 26 provided with the radially directed passages 27 is located around a narrowed rotor portion 28, the surface 29 of which is smooth, in other words there are no mixing members present in the surface 29 which co-act with the passages 27.

Figures 9 and 10 show a part of a pin mixer 36 provided with a mixing ring 35 according to the invention. In this case the rotor 6 is provided with a narrowed rotor portion 30 with two screw threads 31 and 32 which are interrupted with pin passages 33 at the height of pins 34 protruding from the interior surface of the mixing ring 35 into the space between the mixing ring 35 and the rotor part 30.

In the variant according to figures 11-13 the mixing ring 38 is provided with radially directed passages 27 which are connected to each other by means of longitudinal grooves 40 arranged in the external surface 39 and longitudinal grooves 42 arranged in the interior surface 41.

By using passages 27 connected by longitudinal grooves 41 and 42 a narrowed rotor portion 21 with a smooth exterior surface can also be used in this case.

Finally, figure 14 shows a variant whereby the mixing ring 43 is provided on its exterior surface 39 with helically arranged lengthwise grooves 44 and on its interior surface 41 with helically arranged lengthwise grooves 45. The lengthwise grooves 44 and 45 have opposing thread directions. In order to avoid flow-back of material along the lengthwise grooves 44 and 45 during injection moulding the lengthwise grooves 44 and 45 do not communicate with the valve body 17.

It is possible to use in the mixing rings 9 and

26 rows of passages that are not mutually staggered. Accordingly, there are axial strips of material between the rows which results in an increase of the compression strength of the mixing ring.

The mixer device according to the invention can be used for mixing viscous materials such as melted plastics and rubber, materials such as soap and clay in addition to foodstuffs such as dough and margarine.

Claims

1. Mixer device with distributive mixing action for an extruder, an injection moulding machine and the like, comprising a hollow stator and a rotor arranged for rotation in said stator and distributively acting mixing means, **characterized by** at least one separate mixing ring which is provided at least on its interior surface with said mixing means and which is arranged between said rotor and stator around said rotor in a manner such that during mixing there is a positive rotational speed difference between said rotor and said mixing ring.

2. Mixer device as claimed in claim 1, in which the mixing ring is arranged for free rotation around the rotor.

3. Mixer device as claimed in claim 1 or 2, in which the mixing ring cavities comprise passages arranged in the mixing means.

4. Mixer device as claimed in claim 3, in which the passages are radially directed.

5. Mixer device as claimed in claim 3 or 4, in which the exterior surface of the rotor enclosed by the mixing ring is smooth.

6. Mixer device as claimed in claim 3 or 4, in which the exterior surface of the rotor is provided with mixing cavities which are situated opposite to and co-act with the passages.

7. Mixer device as claimed in claim 1 or 2, in which the exterior surface of the rotor is provided with mixing cavities and in which the mixing ring is provided with mixing ring cavities which are situated opposite to and co-act with the rotor mixing cavities.

8. Mixer device as claimed in claims 3-6, in which the passages in the mixing ring are connected to each other by longitudinal grooves arranged in the outer and/or inner ring surface.

9. Mixer device as claimed in claim 8, in which the longitudinal grooves are arranged in helical manner in the mixing ring surface.

10. Mixer device as claimed in claim 9, in which the rotational directions of the helically arranged lengthwise grooves in the outer and inner ring surface are opposing.

11. Mixer device as claimed in claim 1 or 2, in which mixing means comprise pins protruding from the interior surface of the mixing ring into the space between said mixing ring and the rotor.

12. Mixer device as claimed in claims 1-11, in which the mixing ring is provided with an annular valve body that co-acts with a valve seat arranged on the rotor.

13. Mixer device as claimed in claims 1-12, in which a rotor section enclosed by the mixing ring is detachably connected to the adjoining part of the rotor.

14. Rotor section as claimed in claim 13.

15. Mixing ring as claimed in claims 1-13.

16. Extruder provided with a mixer device as claimed in claims 1-14.

17. Injection moulding machine provided with a mixer device as claimed in claims 1-14.

FIG.1

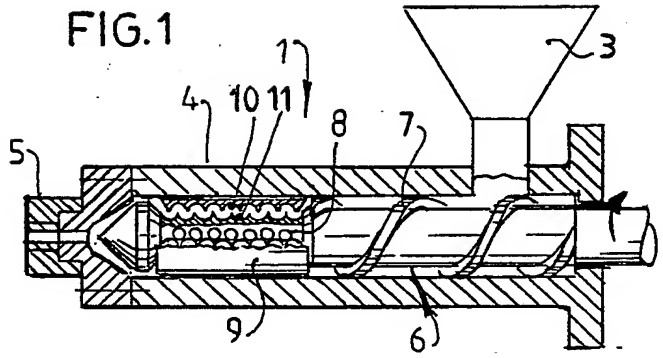


FIG.2

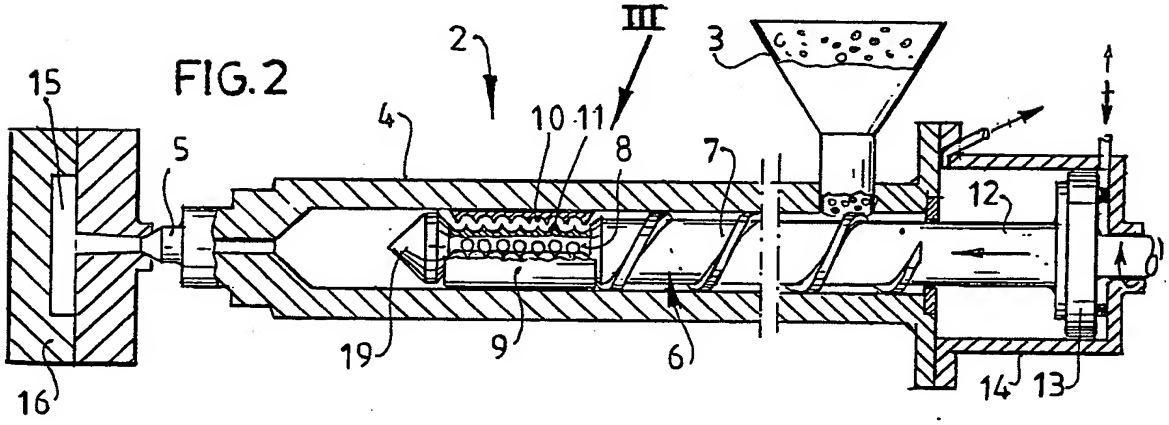


FIG.4

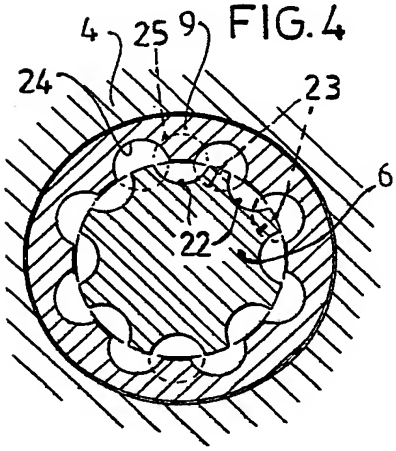


FIG.3

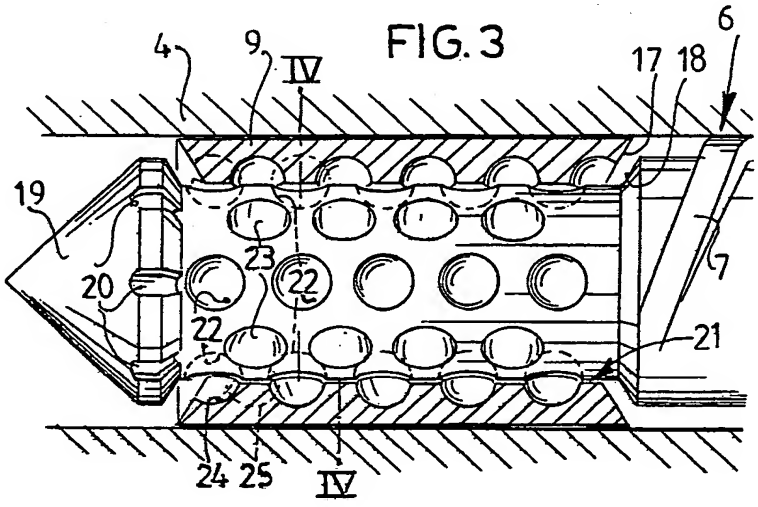


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FIG.6

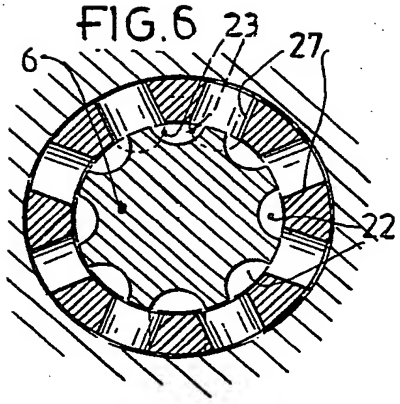


FIG.5

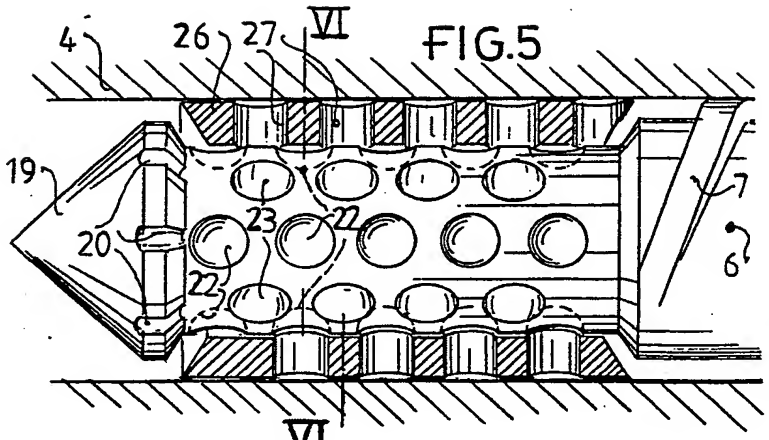


FIG.8

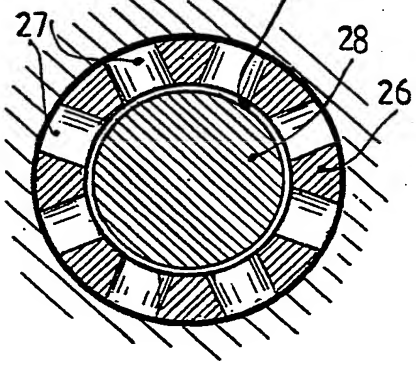


FIG.7

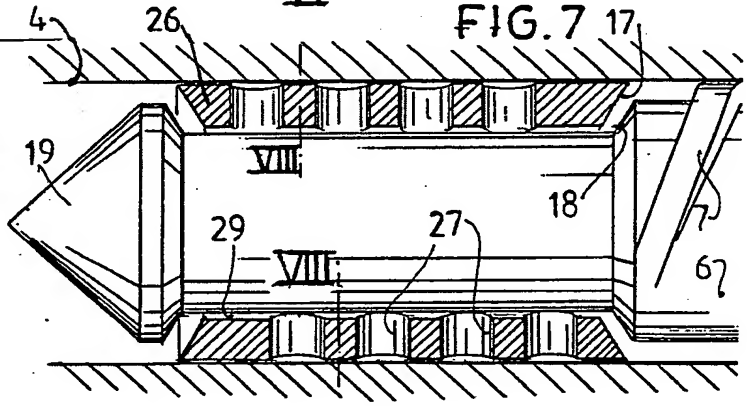
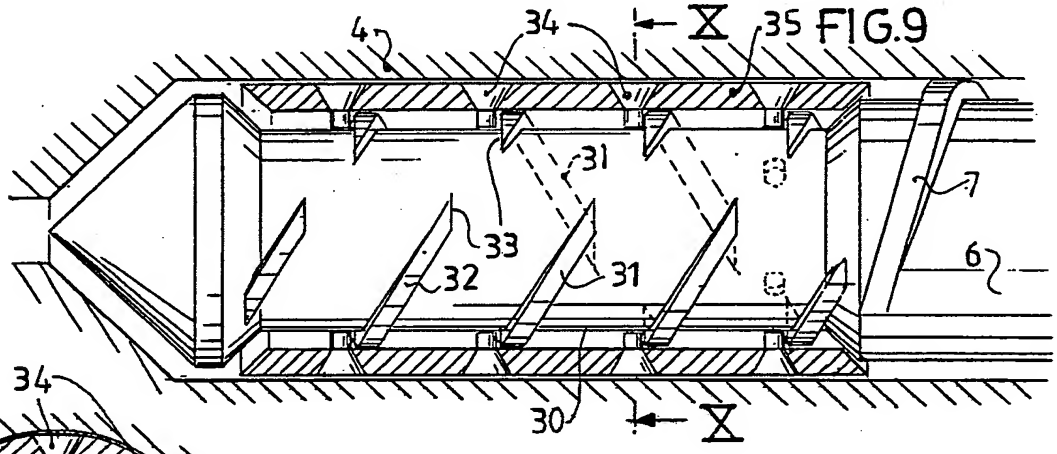


FIG.9



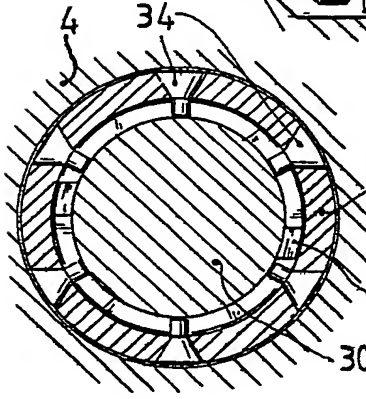


FIG.10

FIG.12

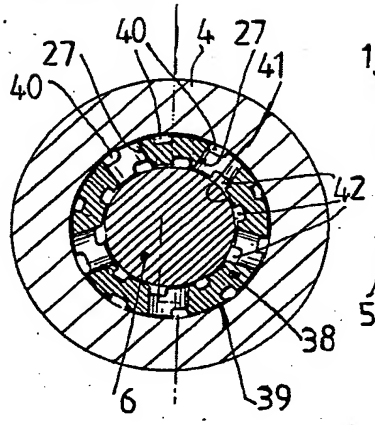


FIG.11

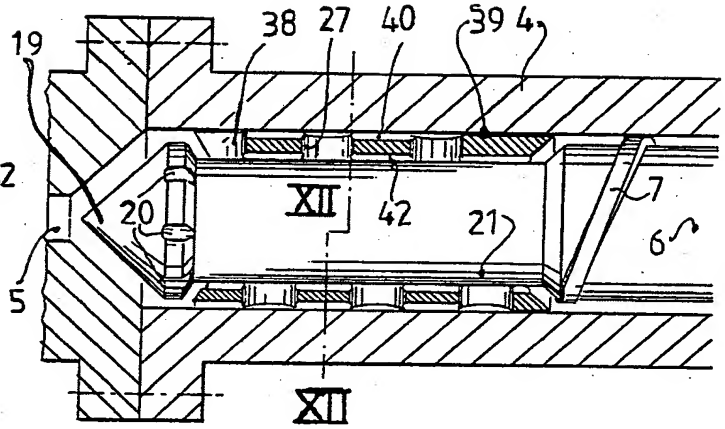
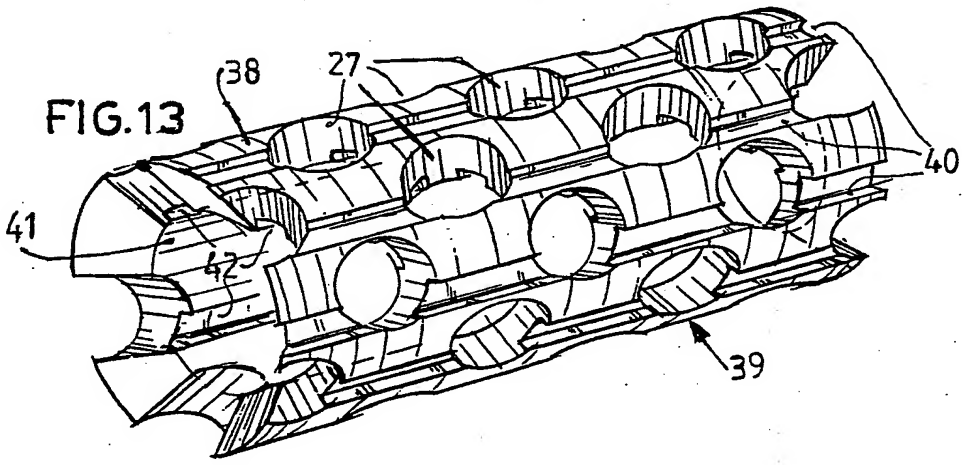


FIG.13



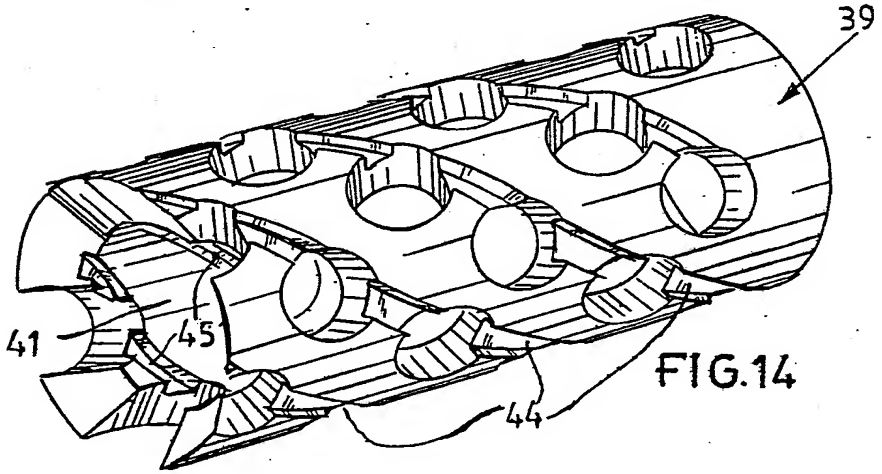


FIG.14

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EUROPEAN SEARCH REPORT

Application Number

EP 89 20 1132

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A-2 327 540 (BASF) * Whole document *	1-5,8, 13-16	B 29 C 45/58 B 29 C 47/64 B 29 B 7/42
X	DE-A-2 162 709 (VEREINIGUNG ZUR FÖRDERUNG DES INSTITUTS FÜR KUNSTSTOFFVERARBEITUNG) * Whole document *	1,11-17	
X	DE-B-1 778 515 (BASF) * Whole document *	1,2,5, 13-16	
X	FR-A-1 523 602 (BAYER) * Whole document *	1-5	
D,A	EP-A-0 048 590 (RUBBER AND PLASTICS RESEARCH ASSOCIATION OF GREAT BRITAIN) * Whole document *	1,6	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 29 C
B 29 B
B 01 F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	31-07-1989	BOLLEN J.A.G.

CATEGORY OF CITED DOCUMENTS

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